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ECONOMIC IMPORTANCE OF GEOLOGICAL AND PHYSICAL CONDITIONS IN TROPICAL AMERICA.

BY

FRANCIS C. NICHOLAS.

It may be affirmed that in Tropical America there are vast regions of unoccupied country capable of supporting an extensive population, of adding enormously to the productive wealth of mankind, and on which many have already become enduringly prosperous; while there are other equally extensive regions in which human life



MAP OF TROPICAL AMERICA NEAREST TO THE UNITED STATES.
The shaded portions represent unfavorable districts.

has been sacrificed in the effort to secure wealth, apparently within easy reach. The conditions, physical or geological, that help to produce results so different are worthy of more attention than they

have received. In submitting observations gathered from an extended experience, my hopes are that, however imperfect, they may be of some service by calling attention to the healthful productiveness of some regions and the unwholesome luxuriance of others, with a few reasons why this should be so in Tropical America.

I have stood where former attempts at colonization have been obliterated in the jungles, with no mark or trace left to indicate the graves of those who went expecting ease and fortune, but found only disappointment and death. Then, on the other hand, I have frequently had for my travelling companions wealthy planters returning to their estates, or on their way to Europe or America to spend their thousands in an annual vacation.

Geographically it is difficult to distinguish with absolute certainty among the various regions, and frequently the favorable and the unfavorable districts lie side by side, but the physical features give some data for comparison.

In a general way it may be said that low lands should be avoided, and that the hill country is favorable; but to this rule there are some exceptions.

The accompanying map gives an outline of the general features of those parts of Tropical America lying adjacent to the United States, and roughly indicates the favorable and unfavorable localities as ascertained in part by numerous explorations in the countries noted, in part by study and comparison of the known physical conditions. These are:

1ST. ATMOSPHERIC.

- a.* The free circulation or absence of the trade-winds, or the presence of local currents.
- b.* Regions of atmospheric stagnation.
- c.* Excessive rains or unusual irregularity of the seasons.

2D. PHYSICAL.

- d.* Natural drainage, its facility, or the contrary.
- e.* The frequency of floods, or their natural absence.

3D. GEOLOGICAL.

- f.* The presence or absence of swamps.
- g.* The condition of alluvial deposits.
- h.* The immediate underlying strata. Porous or impervious, near the surface, or at a depth.
- i.* The water supply.

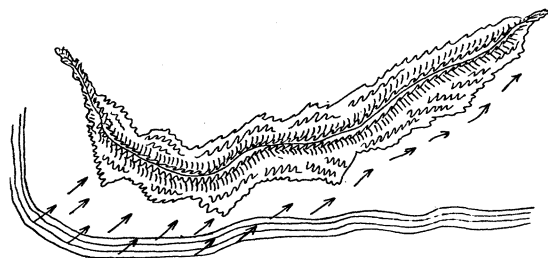
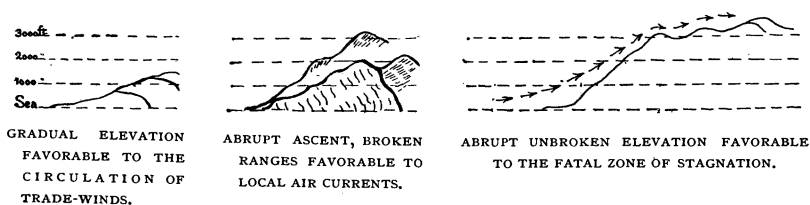
The free circulation of air (*a*) is a well-known advantage. The trade-winds blow continuously, but die away as they approach large

bodies of land. Where conditions are favorable they can be felt for a considerable distance back from the coast.

A body of high mountains near the coast has a tendency to check the trade-winds or to draw them out of their course, and protected valleys in such mountains are apt to be unhealthy. If the ranges are broken, if there are long rivers making their way among them, or if the axes correspond to the usual track of the trade-winds, local currents can be expected.

The checking of the trade-winds by a mountain range has a tendency to create zones of stagnation in the lower atmosphere (*b*). Such a range may draw the air currents toward its summit, and if there is open country behind or long valleys open in the track of the wind, but at a considerable elevation above the zone of stagnation, the winds find an outlet and continue on their way. With low-lying valleys the winds would find a way over the flat country and no zone of stagnation would be formed.

Where mountains lie near the coast, directly in the track of the trade-winds, and especially where their axes correspond to such winds, excessive rains (*c*) can be expected, sometimes over a very long stretch of country, and at such localities the well-known wet and dry seasons of the tropics are scarcely known.



MOUNTAIN CHAIN NEAR THE SEA CONDUCTING THE TRADE-WINDS ALONG ITS FLANK, FAVORABLE TO EXCESSIVE RAINS ON THE EXPOSED SIDE, DRIER ON THE OTHER SIDE IN PROPORTION TO HEIGHT AND EXTENT OF MOUNTAINS.

Natural drainage (*d*) is of the greatest importance, and unless the lands are favorably situated in regard to this matter they are

assuredly fatal. By natural drainage is meant either a clean, gravelly soil, or a continued system of water-ways having a regular unchecked descent. Rivers meandering through low, alluvial formations do not necessarily indicate sufficient drainage, even though their waters may be passing with considerable rapidity and great volume.

Such rivers are subject to floods (*e*), one of the most disastrous conditions to be contended against in Tropical America. To detect and avoid a flood line requires careful study. Floods always leave sediment behind, and regions subject to them are usually flat, with low terraces or undulations marking the varying stages of the water. In some cases, though the land is not actually flooded, the rivers, swollen to their limit by the rainy season, which comes regularly in all low lands, are not sufficient to carry off the water, and thus lands that a little before were dry and promising become almost impassable swamps.

Frequently a river that in the dry season is forty feet below its banks will overflow them in the wet season, and this is most likely to happen if there are sand dunes or alluvial ridges piled up toward the sea.



OUTLINE OF LOW-LYING ALLUVIUM, SHOWING EXAGGERATED FLOOD MARKS. SUCH DEPOSITS ARE FREQUENTLY CUT BY NUMEROUS WATER-COURSES, THE BEDS OF WHICH ARE AT A LEVEL WITH THE MAIN RIVER WHICH IMPERFECTLY DRAINS THE COUNTRY.



OUTLINE OF HEALTHY ALLUVIUM, INTERSECTED BY NUMEROUS WATER-COURSES THE BEDS OF WHICH ARE ALL HIGHER THAN THE MAIN RIVER DRAINING THE COUNTRY.

The geological conditions (3d) are very important. The character of the soil is not of great moment, and fertility is the rule; but the physical outlines indicating the geological structure should be studied with care. In Tropical America there is a diversified country comprising low alluvium, rolling foot-hills, steep mountains, high interior valleys and broad table-lands. All these may be contaminated by the presence of swamps (*f*), more numerous in the low lands and very unusual in the higher mountains.

Swamps that can be seen and provided against do not constitute

so serious a danger as others that fill up in the wet season and become dry shortly after the rains have passed. Such swamps are particularly met with in valleys where the rivers have cut a narrow channel at their outlet, not sufficient to carry off greatly increased volumes of water; also on hill and mountain sides where tilted strata form troughs to retain the water, wherever the underlying strata form basins to retain the surface water, and in low alluvial deposits imperfectly drained.

The structure and condition of alluvial deposits (*g*) is important. It may be safely stated that all recent alluvial deposits are dangerous, particularly those containing silt and partially decomposed vegetable material. Such deposits may be known by their even texture and frequent inclosures of bits of wood beginning to carbonize, with leaves, straws, grasses, etc., but partially decomposed. Older alluvial deposits, which are frequently very desirable, have a firmer appearance, generally considerable coarser material mingled with them, and may contain bits of lignite or possibly impressions of leaves and grasses where clay is bedded in the alluvium.

Shales, marls, clay-beds and limestone or other massive rocks may form (*h*) the underlying strata. If these dip so as to facilitate a convenient drainage, they are favorable, but if their tendency is

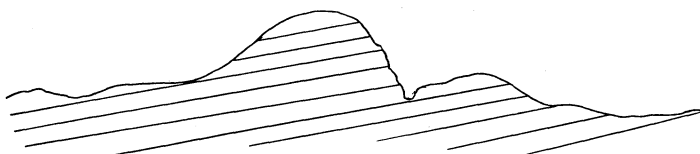


DIAGRAM ILLUSTRATING UNDERLYING STRATA FACILITATING DRAINAGE ON ONE SIDE OF A RANGE OF HILLS, BUT IMPEDING IT ON THE OTHER.



DIAGRAM TO ILLUSTRATE HOW RESIDUAL CLAYS OR UNDERLYING IRREGULAR STRATUM MAY FORM BOG HOLES, OR IF THE SURFACE IS DENUDED POOLS IN WHICH STAGNANT WATER COLLECTS.

to retard the flow of surface water, they are very undesirable, especially if too near the surface, in which case pools of stagnant water are formed, and the emanations are generally fatal to foreigners. The water supply (*i*) is of the greatest importance; it is everywhere abundant, but the question of quality is a serious consideration. In a country that is geologically well endowed the

springs will be clear and abundant, the brooks rapid and unchecked, and such water is perfectly wholesome; but if these same rivers have passed through regions of impeded drainage, they are frequently very dangerous. Spring runs and brooks in recent alluvium should be avoided, and the danger from water draining swamps needs no comment. In the low lands water from the largest river is generally safest.

Generally speaking, the presence of aboriginal remains may be considered favorable, because in the old days people native to the soil naturally sought out the best locations.

These notes and diagrams are made with a view to the economic as well as the scientific interest in the superficial conditions of Tropical America. The question of the eligibility of lands and the reasons, geographical and geological, why some are desirable and others probably fatal, may be worthy of attention from intending settlers. For general information it can be stated that:

A region well endowed will have : Facilities for the free circulation of the trade-winds, or for the development of local air currents. A free drainage, the country sloping to conduct surface water continuously to the sea. The underlying strata will afford facilities for natural deep drainage. Springs with firm banks will be abundant, and the water-courses will be clear and steady. On mountains exposed to the trade-winds rains may be excessive, but this is not a disadvantage where the drainage is good.

A poorly endowed region will have : The trade-winds retarded or shut out by overhanging mountains, which, when facing the sea, will tend to cause the formation of zones of atmospheric stagnation. Low narrow valleys, isolated from the trade-winds, and not favorably situated for the development of regular local air currents. The drainage will be retarded by surface elevations or underlying strata, and floods, stagnant pools and seasonal swamps will develop. Where rains are excessive these disadvantages become assuredly fatal, and under any conditions the region had better be avoided.

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